

Factors affecting the development of collaborative improvement with strategic suppliers

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Competition is moving from the level of individual firms to that of supply chains and networks. Consequently, formerly internal management systems and concepts have to be externalized as well. This includes continuous improvement. The research presented in this article was aimed at increasing the current understanding of the process of developing collaborative improvement in extended manufacturing enterprises (EME). Theory suggested a number of factors to affect that process. Based on action research of a Danish EME involving four companies, a number of additional factors were identified. Not only do these factors influence each other, they also strongly affect the development of collaborative improvement.

Keywords: Collaborative improvement; Extended manufacturing enterprise; Action learning; Action research

1. Introduction

Continuous improvement (CI) is ‘the planned, organised and systematic process of ongoing, incremental and company-wide change of existing practices aimed at improving company performance’ (Boer *et al.* 2000). This definition suggests that CI is an intra-firm activity and indeed, most of the theory on the topic does focus on CI within the firm. However, the battlefield of competition is increasingly moving from the level of individual firms to that of supply chains and networks, including extended manufacturing enterprises (EMEs) (Busby and Fan 1993, Stock *et al.* 2000). Consequently, new approaches must be developed to enhance both the business performance of EMEs and the continuous improvement of their performance, relative to that of other EMEs (Michigan State University 1990–2000).

Due to geographical separations between partners involved, EMEs can hardly rely on established organizational and managerial mechanisms to support

continuous improvement, while the information and communication technology (ICT) needed to bridge these barriers is in its infancy. Then, even with suitable ICT-support, learning to improve collaboratively is a non-trivial, protracted process. Good theories and tools to support collaborative improvement and inter-organizational learning are not currently available.

The EU-funded project CO-IMPROVE (Collaborative Improvement Tool for the Extended Manufacturing Enterprise) addresses this need. Focusing on the learning required to enhance EME-level collaborative improvement, the objective of the project is to develop the following:

- A business model, describing what a collaborative improvement environment might look like, enablers and barriers to achieving such an environment, and possibilities to create the enablers and overcome the barriers. Furthermore, the model describes tools that are available for the partners to manage key aspects of the development process.
- A portal-based software system, enabling and enhancing the capturing, storage, retrieval, and dissemination of knowledge generated as part of

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ongoing collaborative efforts, and through that, facilitating collaboration between, and joint learning by, dispersed partners.

- Implementation guidelines supporting the situational design, implementation and ongoing development of collaborative, EME-level improvement, using the business model and the software system.

The project involves four universities from Denmark, Ireland, Italy and The Netherlands, and two software vendors in Greece and Sweden. Furthermore, three EMEs are involved, consisting of three systems integrators located in Denmark, Italy and The Netherlands respectively, and three to four suppliers each, located in these countries and in the Italian and Dutch cases, in Austria and Germany as well.

The project was designed as follows. First a draft business model was developed on the basis of literature. The bodies of theory used included organization theory (including network theory, transaction cost economics and contingency theory), supply chain management, organizational learning and continuous improvement. Next, the first release of the software system was developed, using the business model and user requirements formulated by the EMEs as main sources. Then, the implementation of both the business model and the software system in the EMEs was commenced. An action learning approach was adopted, in which the EMEs would gradually learn about and master collaborative improvement. The lead software developer would regularly update and issue new releases of the software system, based on experiences and new or revised requirements obtained from the field. The researchers would study the whole process using action research (Coughlan and Coughlan 2002) as their chief methodology in order to be able to gradually improve

the business model, to contribute to the further development of the software system and to infer implementation guidelines.

This article draws on the empirical findings obtained during thirteen months of action learning/action research in the Danish EME. Our aim is to present our understanding of the development of collaborative improvement taking place during that period. First, we present the empirical setting, theoretical background and research design. Next, we describe, discuss, and summarise in a contingency model, the main findings of the research. That model actually presents an extended hypothesis on the impact of a set of interacting factors on the development of collaborative improvement in EMEs. We conclude the article with a summary and directions for further research.

2. Networks and dyads

There is a wealth of theory on interaction between companies. The list of approaches includes fundamental theories such as transaction cost economics (Coase 1937, Williamson 1981) and network theories (e.g. Håkansson 1989) as well as applied theories on outsourcing, purchasing and supply chain management. Equally impressive is the terminology used to describe the interaction between firms. To mention just a few: virtual organizations, extended (manufacturing) enterprises, dynamic networks, strategic alliances and joint ventures.

The term network is perhaps the most generic (or neutral) one catching all the others. As illustrated in figure 1, network theory (Hägg and Johanson 1982, Håkansson 1989) distinguishes four important elements:

- A *network* is formed through the interaction between and among...

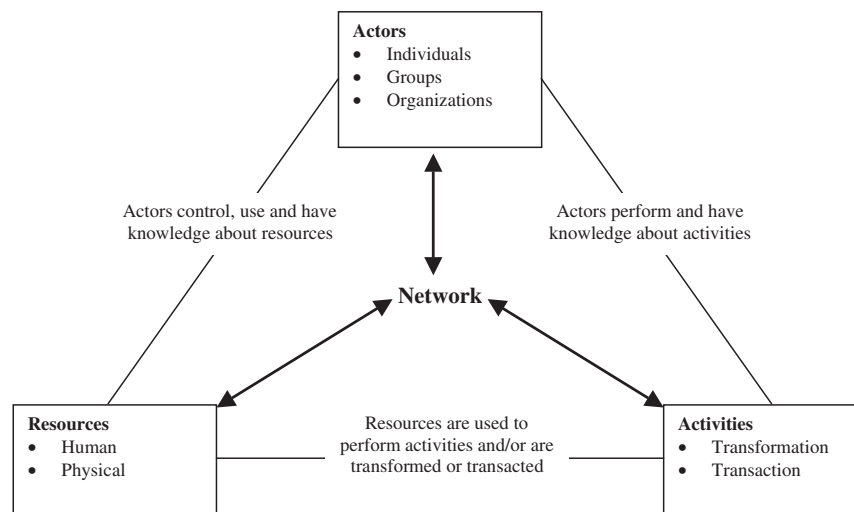


Figure 1. A model of networks (Håkansson 1987, p. 17).

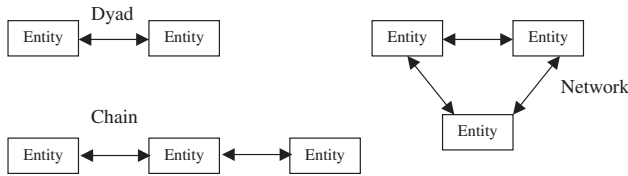


Figure 2. A dyad, chain and network.

- ... *actors* (individuals, groups, organizations) who control and use...
- ... *resources* (human, physical) in order to be able to perform...
- ... *activities* (transformation, transfer).

Though based on a different theoretical background (systems and contingency theory), and using terms like people (actors), technologies (resources) and processes (activities) and organizational arrangements (network), Boer and Krabbendam's (1999) process-based contingency model of organization arrives at a similar conceptualization of organization.

The three forms of network, ranging from the simplest to the most complex form, are dyad, chain and network (figure 2). Focusing, for the sake of simplicity, on a dyadic relationship, then, even if both entities are individual persons, the representation in figure 2 is much too simple as the relationship between two people is usually manifold, including, for example, functional, social, affective, power and political aspects. If the entities are groups, the relationship becomes even more complex, involving the same set of aspects, but a multitude of relationships namely (1) between individuals, (2) between individuals and groups, and (3) between groups. Furthermore, it is not always easy empirically to distinguish a network from its environment, but it is important to do so analytically. That is, a distinction should be made between entities (individuals, groups) and their characteristics that belong to the network (or the dyad) and others that are part of the network's environment.

3. Empirical setting

The empirical field consists of an EME comprising one systems integrator (SI) and three suppliers. The four companies are based in Denmark. The systems integrator produces hydraulics systems for agricultural equipment. The suppliers produce metal parts and foundry products integrated in those systems (see table 1). Two universities (Denmark, Ireland) are involved as action researchers.

At the start there had been long-standing relationships between the SI and each of its suppliers, but not

Table 1. Products and size of the companies involved in the focal EME.

	SI	Supplier 1	Supplier 2	Supplier 3
Products	Hydraulics systems	Metal parts	Foundry products	Metal parts
Employees	> 7500	80	250	65

between the three suppliers. The project started with a few simple collaborative improvement activities in each of the dyads. The idea was to continue on the back of that, gradually involve more individuals and groups on both sides of the dyads, and also to start more complex, multi-dyadic improvement activities, so as to develop a network-level collaborative improvement process and structure.

4. Factors affecting the development of collaborative improvement

4.1 Influential factors

Theory explaining the development of collaborative improvement is lacking. Therefore, the research presented here borrows from adjacent fields of research that have something to say about the design and functioning of, and the interaction between firms. This section identifies seven factors, which may influence the development of collaborative improvement.

A first set of factors is directly related to the fact that the unit of analysis is inter-organizational collaboration. Drawing on virtual organization theory, this means amongst others that (Jägers *et al.* 1998, Jansen *et al.* 1999, Bultje and Van Wijk 1998):

- Participants are geographically dispersed.
- Consequently, electronic communication supported by an ICT infrastructure, may (have to) play an important role in the co-ordination between the participants.
- There is a division of power amongst participants.
- The participants represent different and possibly complementary competencies.
- The set of participants may change over time, depending on the dynamics of the network.

The supply chain management literature mentions partly the same factors. These factors find their basis in organizational behaviour theory:

- Vision, i.e. sense of direction (DiBella and Nevis 1998).
- Commitment (Mohr and Spekman 1994, Monczka *et al.* 1998).

- (Relative) power (Cook 1977, Buchanan and Badham 1999).
- Political behaviour, often discussed in combination with power (Pfeffer 1992).
- Trust (Williamson 1981, Sako 1992, Kumar 1996, McCutcheon and Stuart 2000).

Transaction cost economics points to the role of:

- Human behaviour, with a specific focus on opportunism—‘taking your chances’.
- Contract, which ranges from none via short-term to long-term contract, and from formal legal contract to psychological contract.
- Trust, the glue holding a relationship together, refers to the extent to which a partner is prepared to collaborate with another in the belief (nothing guaranteed) that the actions of the other will be benevolent, not damaging (Child and Faulkner 1998).

Contract and trust are safeguards against opportunistic behaviour. In a way, trust replaces formal contract with psychological contract. Trust does not happen instantaneously, it develops over time through the behaviour shown to others. Managers therefore need to nurture long-term stable relationships with suppliers (Beamish *et al.* 1997). Together, trust and a long-term legal contract may provide a suitable combination to govern the relationship.

Factors affecting functioning and structure proposed in contingency theories of organization and organization design (e.g. Mintzberg 1983, Daft 2001) include:

- Environment.
- Strategy.
- Size.
- Technology.
- Age (or stage of development).
- Culture.

Although in contingency theories the unit of analysis is organization, not networks, these factors, exogenous to the collaboration itself, may affect the relationship.

4.2 Operationalization

We assume that the following factors may play a role in the functioning and development of EME-level collaborative improvement (between brackets terms used above and included in the factors):

- Vision (strategy, sense of direction).
- Individual behaviour (commitment, political behaviour, opportunism).
- Power.
- Trust (and its counterpart: contract; safeguards).

- Competence.
- Partner characteristics (strategy, structure, size).
- Culture.

We assume that the first five factors are best regarded as endogenous to the collaboration, that is, they are related to the individuals and groups directly involved in the collaboration. Partner characteristics and culture are exogenous factors. Table 2 summarises how we operationalized each of the factors.

We decided to leave the following factors out of our analysis:

- Geographical dispersion: All companies are Danish and the distance between the suppliers and the system integrator is in the same range in all cases.
- Network dynamics: The partnership did not change in the course of the research.
- Partner environment and technology: We expect the market, competitive and institutional environment to play a role in the collaboration, but the explanatory power of these factors to be low. The same applies to the role of technology. Culture, essentially also an environmental aspect, is considered as a separate factor.
- Partner age: We do not expect the age of the companies involved to play a key role. All suppliers and the SI are mature companies. We expect strategy, structure and size to be much more important.

The next sections will first address the research design and then report and analyse the main findings of study.

5. Research design

5.1 Research problem

The seven factors identified above may affect the development of dyad-level collaborative improvement. It is not clear though if the set is complete or whether the factors work independently or together and, then, if they reinforce or work against each other.

Therefore, the aim of the research is to find out (1) if the seven factors affect the development of collaborative improvement and, then, how (2) if the set is complete, and (3) if there are any dependencies between the factors. This leads to the following research questions:

- Do the five endogenous and two exogenous factors play a role in the process of developing collaborative improvement in an EME environment, and are there any other factors at play?
- How do the factors affect the process of developing collaborative improvement in an EME environment?

Table 2. Influential factors and their operationalization.

Factors	Operationalization
<i>Endogenous</i>	
Vision	The extent to which the partners involved in the collaboration have shared ideas about the future intensity, organisation and management of collaborative improvement and the way to get there.
Individual behaviour	Shown commitment as well as political and opportunistic aspects, both during direct interaction between actors involved as well as outside such situations.
Power	Measured using the distinction proposed by Weimer and Van Riemsdijk (1998), who distinguished three bases of power namely the levels of: <ul style="list-style-type: none"> • Replaceability—ease or difficulty to find another partner offering or requiring similar capacities and/or capabilities. • Centralization—close or far from where the decisions are made. • Institutionalization—extent to which the partnership is organized, either formally (e.g. legal contract) or informally (e.g. trust, psychological contract).
Trust	The extent to which partners are prepared to engage in new initiatives without formal contracts governing the initiatives.
Competence	Individual and organizational improvement, and project and change management skills.
<i>Exogenous</i>	
Partner characteristics	The individual partner companies' strategy, structure and size.
Culture	National culture.

The first question checks the relevance and completeness of the set of factors identified through literature research. The second question aims at developing explanatory theory.

5.2 Research methodology

The central methodology in the three-year project is action research (by university teams working together with three EMEs) of action learning processes (by the EMEs) (Middel *et al.* 2003). In the course of the project, the software is developed and the three EMEs are expected to gradually learn to improve collaboratively and to use the software to support that. The interventions by action researchers are based on the business model and aimed at facilitating the learning process. The next section provides further details.

6. Empirical findings

At the time of writing, the action learning/action research process had been underway for 13 months. In this section we will give examples of improvement activities undertaken, describe the management of the action learning process, and indicate the results achieved.

6.1 Improvement projects

Table 3 comprises examples of improvement activities undertaken at one, two or all three of the dyads. The examples are representative of the kind of improvements

considered: improvement of quality and delivery performance, rolling out concepts, like TPM (total productive maintenance/management) and lean manufacturing, practised at the systems integrator. A project aimed at linking the information system of supplier 1 to the ERP system of the system integrator was suspended pending the implementation of a new ERP system at the systems integrator's.

6.2 Management of the action learning process

In order to manage the action learning process monthly meetings were held. Typically, the purchasing manager of the SI and three of his purchasers would be present. Furthermore, the managing director/owner of supplier 1, the managing director and the production manager of supplier 2, and the marketing manager (wife of the owner) and/or the quality manager of supplier 3 would attend the meeting. The university would be represented by the four authors, and, often, a representative of another academic partner in CO-IMPROVE, an expert in action learning and action research, would take part as well.

The meetings circulated between the partners and followed a standard agenda:

1. Opening by the host.
2. Company introduction (first four meetings at company premises); introduction of a new initiative by the purchasing manager of the SI, or to a special topic (e.g. strategic partnership, supplier attractiveness) by one of the university staff (most other meetings).

Table 3. Examples of improvement projects.

On...	Improvement projects	Goals
... dyad 1, 2 and 3	Improve the quality of products delivered	Lower than 250 ppm on average
... dyad 1, 2 and 3	Improve the suppliers' delivery performance: Supplier 1: performance rate is 62% Supplier 2: performance rate is 37% Supplier 3: performance rate is 68%	Delivery performance of 97%
... dyad 1 and 2	Roll out TPM from SI to supplier	Roll out TPM in the whole factory at the supplier
... dyad 1 and 2	Implement a kanban system	Implementation of kanban principles with regard to ordering and delivery
... dyad 1	Improve the information flow regarding the ordering process	This project was suspended because the SI was (and still is) in the process of implementing a new ERP system
... dyad 2	Develop an FMEA and VPC standard	Less quality problems Improved start-up of new products
... dyad 3	Develop a purchasing agreement to speed-up and simplify trade between supplier and SI and to reduce unnecessary contact	Improved re-ordering process

3. Report/evaluation of the past month, per dyad, followed by plenary discussion.
4. Break out: discussion per dyad, on improvement plans for next month, involving the supplier representative(s), one of the SI purchasers, and one or two of the university staff.
5. Presentation to plenum. Discussion.
6. Closure.

Between meetings, each of the dyads engaged in improvement activities. The two PhD students (Kaltoft and Nielsen) virtually lived in the companies, each spending approximately four days a week somewhere in the EME, and one day a week at the university for reflection, and feedback to, and discussion with, their supervisors (Boer and Gertsen).

Focusing most of their efforts on the three dyads, rather than the EME as a whole, the two students worked closely together with the suppliers' staff. Plus, in supplier 1, with shop floor personnel, and the three SI purchasers, each of which was responsible for one dyad. They were heavily involved in all the improvement projects and actually partly managed and occasionally even performed part of the improvement activities, making analyses, giving training, devising simple tools, and implementing some of the results themselves.

6.3 Progress made

In effect some improvement projects were started, and most of them completed, quite successfully. Only one project was suspended, pending the implementation of a new ERP system by the systems integrator. The next section seeks to develop an explanation

for progress made in terms of the maturity of the collaboration between the industrial partners.

7. Explanation

In this section we will analyse the impact of the factors listed in a previous section, and of three other factors identified in the course of the study:

- Approach to the process of developing collaborative improvement.
- Communication.
- Commercial reality.

The first two factors are endogenous, the third is exogenous to the collaboration.

The analysis will show that it is the combined influence of, rather than individual, factors, which explains progress actually made.

Vision. At the start of the project, the SI made it quite clear that they wished to roll out their total productive management concept into the supply chain. During the project, the SI also developed the wish to establish strategic collaboration with the three suppliers. However, it took an intervention by the senior academics for the SI to present that idea to supplier 2 and, a few months later, to the other two suppliers as well. The SI had serious difficulties getting the message across to the three suppliers. First of all, the company only had a conceptual picture of what they wanted to achieve and found it difficult to express that concept in more operational terms. Furthermore, suppliers 2 and 3 did not trust the SI (see below), which did not make the discussion any easier.

Also, all four companies lacked a clear vision on and a deep understanding of collaborative improvement, its prerequisites and consequences. Interestingly, the previous owner of supplier 1, father of the present owner/MD, at a pre-meeting five months before the actual start of the action learning process, had asked: ‘What do we want to achieve with this project, where do we want to be in five years time?’ An intervention by the university team, 10 months into the project, created a somewhat clearer picture for the industrial partners.

Competence. None of the suppliers had previous experience with continuous improvement, while the SI’s ample experience with total productive management was limited to its own organization. Most importantly though, none of the persons involved (the SI’s purchasers and the suppliers’ MDs) were experienced change agents or (improvement) project managers. This was detrimental to both the small improvement projects as well as the learning from these activities needed to create a more mature collaborative improvement environment.

The companies’ lack of improvement and change competence required the PhD students to play a very active role. At the same time, however, their involvement made life easier for the companies and did not contribute to the EME becoming more mature. At the vision meeting, in month 10, it was therefore decided to reduce the students’ role to project managers, to change the project team to a steering committee, and also to change frequency to bi-monthly meetings. It is too early at this stage to say much about the effects of this change of approach.

Approach. This factor emerged in the course of the research, and is best characterized as bottom-up learning-by-doing. The researchers’ motive to propose this approach was that the companies would complete a number of improvement projects together and from this develop a more mature collaborative improvement environment.

Supplier 1 was the most ambitious of the three. Suppliers 2 and 3 remained reluctant well into the project. This further increased the need for the researchers to be heavily involved, in dyad 1 to assist in the manifold of activities developed, and in dyads 2 and 3 to get and keep the process going. At the monthly workshops small groups, consisting of a researcher, a purchaser from the SI and the suppliers’ managing (suppliers 1 and 2) or marketing (supplier 3) directors, identified improvement projects, developed a project plan and presented this in plenum. Most initiatives were relatively simple, aimed at quick success, and involving only a few people. Between workshops the researchers interacted intensively with the dyads to facilitate the improvement projects and (try to) make

the collaboration more mature. Only after the vision discussion in month 10 did the companies feel confident enough to take over, so that the researchers could withdraw on a more research-oriented role.

Culture. National culture (preference for small steps, dialogue and consensus) explains the companies’ motivation to adopting this approach. In the case of suppliers 2 and 3 this combined with lack of vision (‘let’s start slowly and see what happens’).

Communication. This factor also emerged from the research. Communication in the dyads naturally evolved around the improvement projects, but was highly influenced by lack of trust and improvement competence. Hidden agendas characterized the communication in dyad 2, while the communication between supplier 3 and the SI was not very open either. While communicating politely at the monthly meetings, the real opinions the three partners held about each other surfaced several times when researchers visited the individual companies. The communication in dyad 1 was much more open and honest, and all individuals involved had a win-win attitude. The reasons for this are described further on in this section.

Power. Table 4 summarises the suppliers’ power position. Suppliers 1 and 2 deliver a large portion of their total turnover to the SI. Supplier 3 hardly depends on the SI for its sales. Suppliers 1 and 3 (components) are easy to replace, supplier 2 (castings) is not. The relationship between the SI and suppliers 2 and 3 is arm’s length. Supplier 1 has always made an issue of having as good as possible relationships with the SI. After graduating from university, the current owner-manager actually worked at the SI, and in those days he developed a good personal relationship with the boss of the current purchasing manager at the SI. No formal contracts exist between any of the suppliers and the SI.

Commercial reality. This is the third factor that emerged during the research. Fluctuations in demand and price-based competition in its own markets force the SI to continuously look for good but cheaper suppliers. In the past this had led the company to impose price reductions on and remove turnover from suppliers 2 and 3. Although, later, most of the turnover was given

Table 4. Drivers of the suppliers’ power position.

	Supplier 1	Supplier 2	Supplier 3
Replaceability	High	Low	High
Centrality	Medium/high	Low	Low
Institutionalization	Low	Low	Low
Overall assessment	High	Medium	Low

back to them, these suppliers' trust in the SI had suffered. Also during the period reported here, the SI told supplier 3 that they might be forced to further reduce prices, and they actually took turnover away from supplier 2.

Trust. Suppliers 2 and 3 never trusted the SI. Mistrust further increased as they felt that a collaborative relationship was at odds with the way the SI imposed commercial reality on them. Supplier 2 suspected that the SI had invited them to the project to get insight in its core foundry competencies, which they were afraid the SI would use to find alternative suppliers. In contrast, a high level of trust existed between the SI and supplier 1, which was based on the friendship between the owner and individual employees at the SI. An open relationship based on a clear commitment from both sides reinforced the mutual trust.

Individual behaviour. In dyad 2 lack of trust at the supplier's side, the power game played by the SI and lack of vision of the partners led to political behaviour. In dyad 3, the SI showed the same behaviour, but the supplier's reaction is best characterized as opportunistic ('we don't need them, they need us'). In dyad 1, mutual commitment to the collaboration dominated the relationship.

Company characteristics. Company strategy, size and structure affected progress made. During the meetings, the SI strategy dominated the discussion to the extent that the improvement projects selected followed that strategy, rather than the strategies of suppliers 1 and 3. Supplier 3 just followed. Supplier 1 was actually more ambitious than the SI, but here the structure of the much larger customer played a detrimental role. One of the projects proposed involved establishing a link between the SI and the supplier's information systems. That project never came off the ground, due to the fact that the SI was in the process of implementing a new ERP system. Informational linkages with suppliers would perhaps come, but the SI's Information Department was not prepared to take that up at this stage of the ERP implementation process. The strategy of supplier 2 went against the SI strategy. Ongoing communication problems, political behaviour and continuous mistrust were the results.

7.1 Effects

Dyads 2 and 3 experienced major dips in the process towards collaborative improvement and the relationship only slightly improved. Dyad 1 experienced a steady process and the relationship improved even further. In total, the companies initiated 13 improvement

projects, 12 are ongoing and one is suspended. Dyad 1 was the most active of the three and engaged in the most complex projects. Dyad 3 was also relatively active, but all projects were minor in terms of complexity and performance improvement. Dyad 2 was the least active one, and did not manage to achieve any significant performance improvement.

8. Discussion

Table 5 lists the 10 factors and effects identified above and shows their development over time. The findings confirm that vision, competence, power, trust, individual behaviour and, albeit indirectly, partner characteristics and culture play a role in the development of collaborative improvement. In addition, the research identified approach, commercial reality and communication as influential factors.

The influence of lack of vision and competence reduced over time. Approaches were changed—the effects however are not clear. Communication did change and had a positive effect on the collaboration. The level of trust between the partners fluctuated. Commercial reality, power, company characteristics and their influence did not change over time. Individual behaviour in terms of commitment (dyad 1), politics (dyad 2), and a mixture of politics and opportunism (dyad 3) did not change either. The role of culture was strongest at the beginning of the project, but continued playing a role in the background.

Figure 3 shows the ten factors and also how they influence each other. Culture was one of the factors determining the choice of approach; (lack) of vision was the other. The approach chosen did generate tangible improvements, which took the focus somewhat away from disabling factors such as political and opportunistic behaviour, and poor change and improvement competencies. The active involvement of the researchers had a substantial influence on the improvements achieved, the communication between the partners, and vision development. At the same time, this heavily facilitated learning-by-doing approach had its limits, as it did not help the EME develop a more mature collaborative improvement capability.

Trust and commitment dominated in dyad 1, compensating for the supplier's, at first sight relatively weak, power position and the partners' lack of shared vision. Lack of trust based on the SI's acting on commercial reality, lack of a joint vision amplified by opposing company strategies, and the difficulty to find alternative suppliers, caused political behaviour to dominate the relationship in dyad 2. Feeling that they hardly depended on the SI, supplier 3 acted opportunistically

Table 5. Factors influencing the development of collaborative improvement.

	Dyad 1		Dyad 2		Dyad 3	
	Customer	Supplier	Customer	Supplier	Customer	Supplier
Vision (start)	Low/medium	Low/medium	Low/medium	Low	Low/medium	Low
Vision (today)	Medium/high	Medium/high	Medium/high	Medium	Medium/high	Low/medium
Competence (start)	Low/medium	Low	Low/medium	Low	Low/medium	Low
Competence (today)	Medium	Medium	Medium	Medium	Medium	Medium
Power (start)	High	Medium	High	Medium	Medium	Low
Power (today)	High	Medium	High	Medium	Medium	Low
Trust (start)	High	Medium/high	Medium	Low	Medium	Low
Trust (today)	High	High	Medium	Low	Medium	Medium
Individual behaviour	Commitment	Commitment	Politics	Politics	Politics	Opportunism
Partner characteristics	Large bureaucratic	Small organic	Large bureaucratic	Medium-sized bureaucratic	Large bureaucratic	Small bureaucratic
Culture	Preference for small-step change, dialogue and consensus					
Approach	Bottom-up learning-by-doing, facilitated by workshops and face-to-face meetings, intensive researcher-facilitation					
Commercial reality	Positive		Negative		Neutral	
Communication (start)	Open, intensive, aimed at 'fire fighting'		Intensive, aimed at 'fire fighting', hidden agendas		Intensive, aimed at 'fire fighting', not open	
Communication (today)	Open, intensive, more improvement oriented		Intensive, more improvement oriented, still: closed books		Intensive, more open and improvement oriented	
Effects on the collaboration	Steadily improved and ambitious		Improved a bit but major dips and conflicts		Improved a bit but fragile	

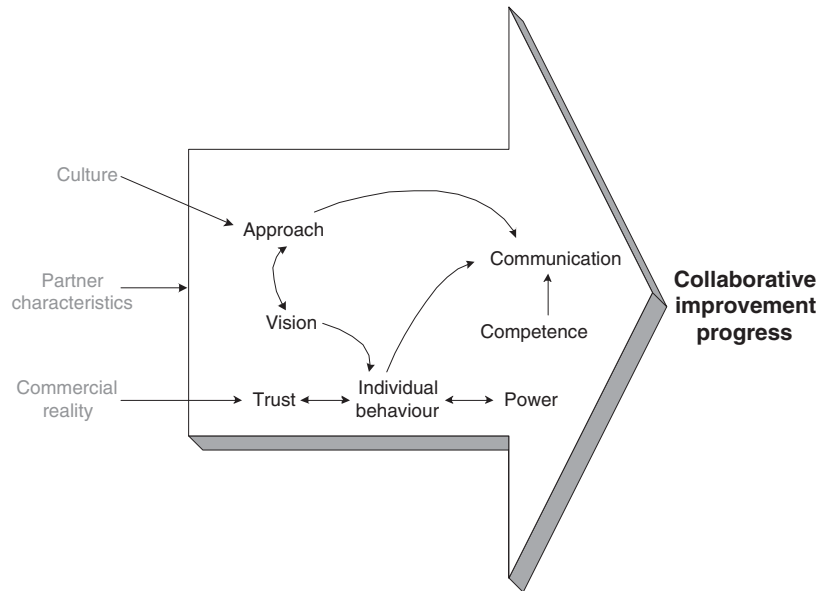


Figure 3. A contingency model of the development of collaborative improvement.

and found the political behaviour of the customer actually a bit annoying.

9. Conclusion

The objective of the article was to identify factors affecting the process of getting collaborative improvement in an EME environment up and running, and to investigate how these factors influence each other and the collaboration. One systems integrator with three suppliers provided the empirical setting. Through literature study and action research, a number of endogenous and exogenous factors were identified, see figure 3.

Some of these factors stem from adjacent areas of research (network theory, transaction cost economics, contingency theory). The research confirms the expectation that they play a role in collaborative improvement too. The endogenous factors distinguished are vision, competence, power, trust, and individual behaviour. Culture and partner characteristics, especially strategy, structure and size are exogenous to the collaboration, but affect what is happening in the dyads. Three other factors emerged from the research, which we had not envisaged at the start of the research. Approach and communication are endogenous factors, commercial reality is an exogenous factor.

The ten factors play a role in all dyads, but none of them has decisive influence; it is their interplay that determines the development of the collaboration. This also means that the positive influence of some factors can neutralise or even overcome the negative influence of others. For example, commitment (individual

behaviour) together with friendship-based centrality (power) and trust (trust) may more than compensate for a supplier's high replaceability (power). Some factors, in particular (lack of) vision and competence, as well as (mis)trust, seem stronger than others. Finally, the same factors can be beneficial and detrimental to collaborative improvement, dependent on the setting in which they play their roles. An example is commercial reality, which can be perceived and handled as a problem, but also as a challenge.

We believe we identified the most important factors affecting the development of collaborative innovation. However, further research is needed to be able to say something about their manageability and to infer guidelines for other EMEs intending to engage in the adventure called collaborative improvement. Further research is also needed to find out if there are no better approaches to bottom-up learning-by-doing. The Dutch part of the CO-IMPROVE project has opted for a 'laissez-faire' approach. As this did not work the EME was changed to a more directive role for the systems integrator, which seemed to work much better. The Italian EME went for the top-down creation of an environment suiting collaborative improvement, which did not seem to work either, until concrete improvement projects were started.

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